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Ritual and economic activity during the Neolithic in Schleswig-Holstein, northern Germany: an approach to combine archaeological and palynological evidence

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ABSTRACT

Detecting the intensity of human activities relating to ritual and subsistence behaviours is a daunting challenge in cases where settlement sites are not readily detectable in the archaeological record. We explore the utility of using palynological and archaeological data derived from monumental burial complexes in order to better understand the relationship between ritual activity and subsistence activities. Our case study focuses on the late Funnel Beaker (3500–2900 cal BC) and Single Grave periods (2900–2200 cal BC) in northern Germany. Here, high values for ritual activities correlated significantly with high values for economically induced landscape opening for the megalithic period (3500–3100 cal BC). In the Single Grave Period, an overall agreement of general trends between the two proxies can be observed, i.e. a declining trend in economic activity is generally associated with decreasing evidence for ritual activities and vice versa. Furthermore, our results suggest regional variation in the intensities of ritual and economic activity during both the Funnel Beaker and the Single Grave periods. We postulate a Funnel Beaker core area in the eastern part of the study area, where interdependent economic and ritual structures formed a basis for a stable socio-economic system which inherited the resilience to the adoption of innovations and new ideologies. In the western part, Funnel Beaker groups with a less intensive economic impact and a weaker interlinkage of ritual and economic activities were more open to ritual innovations emerging after 2900 cal BC, as expressed by the construction of Single Grave burials.

1. Introduction

The transition from the Funnel Beaker to the Single Grave Period at 2900 BC in northern Europe has often been interpreted as a fundamental socio-economic break (Müller, 1898; Kossinna, 1928; Childe, 1925; Glob, 1944; Shennan, 1976; Kristiansen, 1984, 1989; Damm, 1991; Czebreszuk, 2002; Strahm, 2002; Vandkilde, 2006; Vander Linden, 2007; Furholt, 2011). The reason for this is the marked change in burial rites and material culture. Hereby, it is often assumed that economic patterns change synchronously. The poor representation of settlements in the archaeological record, however, hampers the reconstruction of economic change and its relation to social developments.

An approach to overcome the lack of settlement data is to use the number of newly constructed grave monuments as a proxy for social and/or ritual activity and compare it with available evidence for economic activity. The later can be provided by palynological investigations and the usage of indicator taxa for human activity (cf. Behre, 1981). We therefore attempt to investigate the relationship between patterns of social and ritual activities, represented by the burial monuments of Funnel Beaker and Single Grave societies, and economic activities as induced from pollen data in the time from 3500 to 2200 BC on a regional level, focussing on the northern German province of Schleswig-Holstein. Based on this approach we aim to explore to what extent social and economic activity show parallel or diverse patterns of change, and whether there could have been a constitutional relationship between these two domains of human activity. If so, the following question is whether there is evidence for regional or temporal variance in this relationship and how this could be explained.

1.1. Study area

The focus of this study is the development of human activity and settlement patterns during the 4th and 3rd millennium BC in Schleswig-Holstein, the northernmost state of Germany (Fig. 1). From an archaeological point of view the study area comprises the

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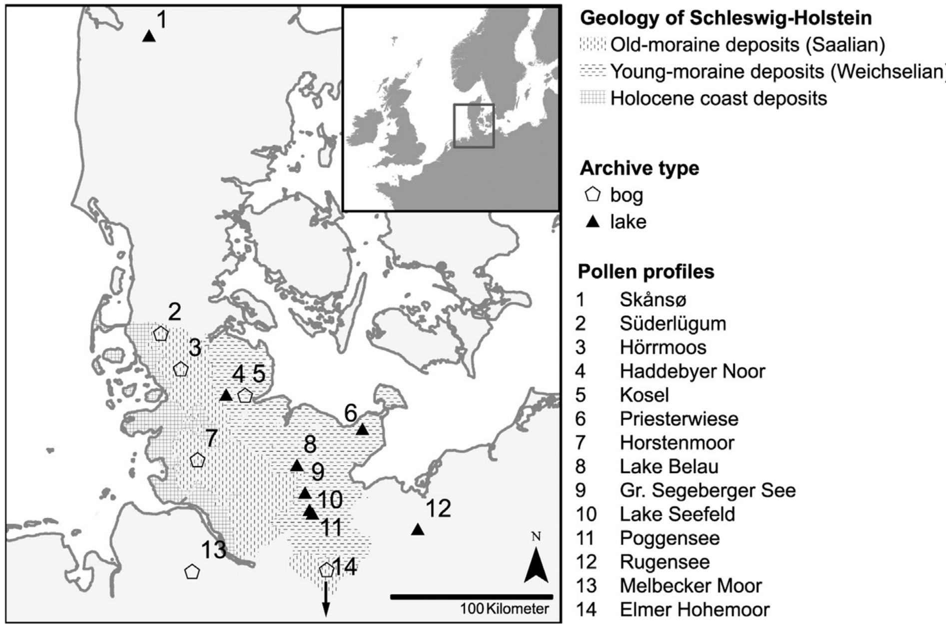

Fig. 1. Map of study area and locations of pollen sites used in the present study. Main geological regions of Schleswig-Holstein are indicated.

south-western part of the so-called Funnel Beaker North Group (Midgley, 1992; Bakker, 1979; Furholt, 2012b). The area is part of the Cimbric peninsula or Jutland, which is characterised by three different geological regions (cf. Fig. 1). These regions are important for considerations regarding prehistoric land use as they, just as nowadays, must have provided different natural resources for agriculture. The eastern part, the so called young moraine area, was glaciated during the last glacial maximum. Here, comparatively fertile soils, predominantly luvisols, developed in the glacial drift during the Holocene. In contrast, the area to the west, i.e. the old moraine area, is characterised by relatively poor soils, mainly podzols, which have developed in flat sandur areas and old moraine deposits. Along the west coast flat marsh deposits developed during the second half of the Holocene.

The dominating natural vegetation during Neolithic times was dense mixed oak woodland (Nelle and Dörfler, 2008). Natural open habitats were restricted to specific environmental conditions, e.g. coastal areas, lake shores, bog surfaces. First evidence for extensive opening of the natural woodlands and the establishment of open agricultural areas dates to ca. 3750 cal BC (Feeser et al., 2012).

2. Material and methods

2.1. Archaeological data

2.1.1. Archaeological proxy

The construction of grave features, such as megalithic chambers, barrows, stone frames, stone cists and wooden chambers, are taken as indicators for an inherently socially induced activity. As the re-use and continuous use of already existing grave structures is a common phenomenon, we only count the number of newly constructed grave structures. The re-use of existing structures is regarded to be associated to a habitual maintenance of the status quo, whereas the construction of new graves reflects the productivity in a sphere of ideology and ritualised behaviour, which adds a new permanent structure to the landscape. We therefore consider the number of newly constructed graves to reflect active (re-)negotiation of ideological values, and thus as a proxy for ritual activity.

2.1.2. Data compilation

The archaeological data consists of 424 grave constructions that date between 3500 and 2200 cal BC. This dataset is based on two archaeological catalogues, one accounting for megalithic graves of the 4th millennium BC (Sprockhoff, 1966) and one of dateable graves of the Single Grave Period (Hübner, 2005). The two archaeological catalogues used are the best available databases because they combine both a large regional scale and provide a relatively fine chronological phasing (see Chapter 2.3).

As the data consists of two very different grave types, the question might emerge, if it is appropriate to compare the collective megalithic grave structures with the individual single grave structures. As pointed out above, the archaeological proxy as we define it is not dealing with the number of individuals buried, but with the number of new structures built. These represent collective acts of grave constructions, which do require more or less comparable workloads (cf. Furholt and Müller, 2011; Hübner, 2005). Thus, we regard these two kinds of structures as equivalent concerning our proxy of ritual activity.

2.2. Environmental data

2.2.1. Palynological proxies

The relative abundance of *Plantago lanceolata* pollen (ribwort plantain) is used as main pollen analytical proxy for human activity in this study. This ‘classic anthropogenic indicator’ (Behre, 1981) is regarded to have played an important role in vegetation communities related with pastoral and agricultural activities. Therefore increased evidence for *P. lanceolata* is used as a palynological proxy for human activity or landscape openness, respectively. Pollen of wild grasses (Poaceae) were chosen as additional pollen taxon, as the relative abundance of grasses, as reflected in the pollen diagrams, generally correlates well with human activity or landscape openness, respectively.

2.2.2. Data compilation

The pollen analytical data comprises ten sites from the main study area, i.e. Schleswig-Holstein (Table 2). One site from Denmark (Fig. 1.1), lying in a sandur area at the margin of the weichselian

Table 1
Details of time slices used in present study.

Time cal BC	Phase		Number of grave constructions recorded for Schleswig-Holstein
3500–3100	(1)	Megalith construction phase	314
3100–2900	(2)	Post-Megalith phase	–
2900–2750	(3)	Earliest Single Graves (Phase Hübner 1a)	24
2750–2600	(4)	Early Single Graves (Phase Hübner 1b)	48
2600–2450	(5)	Single Graves (Phase Hübner 2)	17
2450–2350	(6)	Late Single Graves (Phase Hübner 3a)	6
2350–2250	(7)	Latest Single Graves (Phase Hübner 3b)	15

glaciation, was chosen for comparison reason as it represents an area with a particular high concentration of graves from the Single Grave Period. Data from three additional sites from regions adjacent to the study area (Fig. 1.12–14) are only used for the creation of pollen isomaps.

Whenever possible pollen raw counts were obtained, otherwise the data was digitised from scanned pollen diagrams using the Engauge Digitizer software (www.digitizer.sourceforge.net). In the case of digitised data either relevant pollen counts were given in the publication or the presentation of the data as relative values in relation to an arboreal pollen sum allowed recalculations to a uniform modified arboreal pollen sum. Here we use the sum of natural mixed oak forest taxa (i.e. *Quercus*, *Tilia*, *Fraxinus* and *Ulmus*) to calculate the relative abundance values for the selected indicator species (*P. lanceolata* and Poaceae) for all pollen profiles.

Details regarding chronological information used for the individual sites are given in Table 2.

Inline Supplementary Figs. S1–S13 can be found online at http://dx.doi.org/10.1016/j.jas.2013.01.021.

Based on the created age-depth models best age estimates, i.e. in case of OxCal models (Bronk Ramsey, 2008) modelled median ages, were constructed for each pollen spectrum.

2.3. Comparison of the two proxies

In order to investigate the relationship of ritual and economic activities we compare the archaeological and palynological data within seven time slices between 3500 and 2200 cal BC (cf. Table 1 and below). These phases are reflecting the archaeological chronology of the graves used in this study. The chronological estimates of the construction and use of megaliths in Northern Germany has recently been substantially improved through directed Bayesian dating projects (Mischka, 2011). However, as this work is based on local studies it does not necessarily apply to the whole study area. We therefore use a two phased archaeological chronology for the Funnel Beaker Period that places the erection of the majority of megaliths in northern Germany between 3500 and 3100 cal BC (phase 1), followed by a period of a drastic decline in building activities of megaliths (phase 2) from 3100 to 2900 cal BC (Jensen, 2006). For the Single Grave Period we use the chronological phasing of Hübner (2005). She distinguishes five phases (3–7; 2900–2750 cal BC, 2750–2600 cal BC, 2600–2450 cal BC, 2450–2350 cal BC, 2350–2250 cal BC) based on the results of a correspondence analyses of grave good typology and radiocarbon dating (Hübner, 2005). We are aware that this temporal interpretation of the sequence is an approximation to a general trend in material culture development. However, as our approach is an explorative one, we use these phases in a heuristic way in order to get the main trend and generally refrain from any conclusion based on single phases.

The archaeological proxy therefore comprises the distribution and number of graves within a given phase. The palynological proxy is based on average values of the indicator taxa for each phase and pollen diagram.

Table 2
Details of pollen profiles used in the present study.

Site	Archive type	Size (ha)	Author	Nr. of spectra between 3500 and 2250 cal BC	Number of ^{14}C dates used in age-depth model (Total/Neolithic)	Additional age information	Age-depth model
Skånsø	Lake	12	Odgaard (1994)	14	23/6[c]	–	As published
Süderlügum	Raised bog	8	Kubitzki (1961)	6	6/1[c]	–	OxCal (Inline Supplementary Fig. S1)
Hörrmoos	Raised bog	120	Dörfler (2000)	6	16/1[b,c]	–	OxCal (Inline Supplementary Fig. S2)
Haddebyer Noor	Lake	102	Dörfler (unpubl.)	59	1/– [b,e]	Varve counting, pollenstratigraphy	(Inline Supplementary Fig. S3)
Kosel	Raised bog	2	Dörfler (2001)	23	13/4[c]	–	Oxcal (Inline Supplementary Fig. S4)
Priesterwiese	Palaeolake	5	Averdieck (2004)	16	11/2[c]	Pollenstratigraphy	Oxcal (Inline Supplementary Fig. S5)
Horstenmoor	Fen	1	Dörfler (2005)	10	6/2[b,d]	–	OxCal (Inline Supplementary Fig. S6)
Lake Belau	Lake	115	Wiethold (1998)	62	12/1[b,e]	Varve counting	OxCal (Dörfler et al., 2012; Inline Supplementary Fig. S7)
Gr. Segeberger See	Lake	173	Feeser et al. (2012)	33	6/3[b,e]	Pollenstratigraphy	OxCal (Feeser et al., 2012; Inline Supplementary Fig. S8)
Lake Seefeld	Lake	6	Averdieck (1990)	50	–	Pollenstratigraphy	Clam (Feeser et al., 2012; Inline Supplementary Fig. S9)
Poggensee	Lake	9	Feeser et al. (2012)	65	7/4[b,e]	Varve counting	OxCal (Feeser et al., 2012; Inline Supplementary Fig. S10)
Rugensee[a]	Lake	55	Dörfler (2011)	35	8/2[e]	Pollenstratigraphy	OxCal (Inline Supplementary Fig. S11)
Melbecker Moor[a]	Raised bog	29	Kubitzki (1961)	9	4/1[c]	–	OxCal (Inline Supplementary Fig. S12)
Elmer Hohemoor[a]	Raised bog	330	Heider (1995)	9	11/2[c]	–	OxCal (Inline Supplementary Fig. S13)

OxCal[P]: age-depth model was constructed using the P_Sequence deposition model of Oxcal 4.1 (Bronk Ramsey, 2008).
OxCal[V]: age-depth model was constructed using the V_Sequence deposition model of Oxcal 4.1 (Bronk Ramsey, 2008).
Clam: age depth model was constructed using the smooth spline function of clam software (Blaauw, 2010).
[a] Sites only used for interpolation for pollen isomaps.
[b] Unpublished ^{14}C dates.
[c] Conventional ^{14}C dates on bulk samples.
[d] AMS ^{14}C dates on bulk samples.
[e] AMS dating of terrestrial macrofossils.

In order to compare both proxies two approaches are used:

1. The data will be compared at the level of individual sites, i.e. one value for each proxy is calculated for a specific point in the landscape. This primarily is used to explore the correlation of both proxies on a site level. Pollen data a priori provide such data, but archaeological data have to be transformed. This is done by calculating distance weighted grave concentration values for each pollen site, in order to balance the spatial significance for both proxies, assuming that activities nearer to the pollen site have had a greater impact on the anthropogenic pollen signal. Therefore, we count the number of graves within a 25 km buffer zone for each period (Fig. 2) and applied a logarithmic inversed distance weighting for each 5 km zone, as illustrated in Fig. 3.
2. The data will be compared on a spatial scale in order to help to identify regional patterns. This is done by mapping the distribution of graves on isopollen maps for indicator species for each phase. Isopollen maps were created using the inverse distance weighting method (IDW, $p = 4$ and a search radius of 50 km) as implemented in the Geostatistical Analyst, ArcGIS 9.3 (ESRI).

3. Results

A comparison of the archaeological and pollen analytical proxies at the level of individual sites is shown in Fig. 4. The comparison on a spatial scale is given in Fig. 5.

In Fig. 6 the results of a test for linear correlation between the two proxies at the level of individual sites (cf. Fig. 1.1–11) are given. We tested the calculated distance weighted grave constructions proxy values against the values of *P. lanceolata*, i.e the main palynological proxy for each phase. A direct quantitative and statistically significant correlation between both proxies exists for the time slice 3500–3100 cal BC in the study area. For the individual phases of the Single Grave Period (results not shown), but also for the combined phases (2900–2250 cal BC), no significant correlation was found (cf. Fig. 6).

Comparing the general development of the proxies for the different sites, groups of sites with similar patterns can be distinguished. These regional variations are also well documented in the spatial comparison (Fig. 5).

Along the Baltic coast, represented by the three profiles of Kosel, Haddebyer Noor and Priesterwiese, both proxies show high values during phase 1 (3500–3100 cal BC). Hereby, maximum values of both proxies are recorded at the site of Kosel. In the following periods, the values of both proxies decrease significantly. A slight trend towards rising values in the archaeological proxy is recorded for the latest Single Grave phase (Fig. 4, 2350–2250 cal BC), when the first Single Grave barrows were erected in the area (Fig. 5). For this phase also the pollen proxy of Kosel and Priesterwiese increases slightly (Fig. 4).

An inverse pattern is found for the southern central younger moraine area, which is represented by the two profiles of Poggensee and Lake Seefeld. Here, both proxies are relatively low

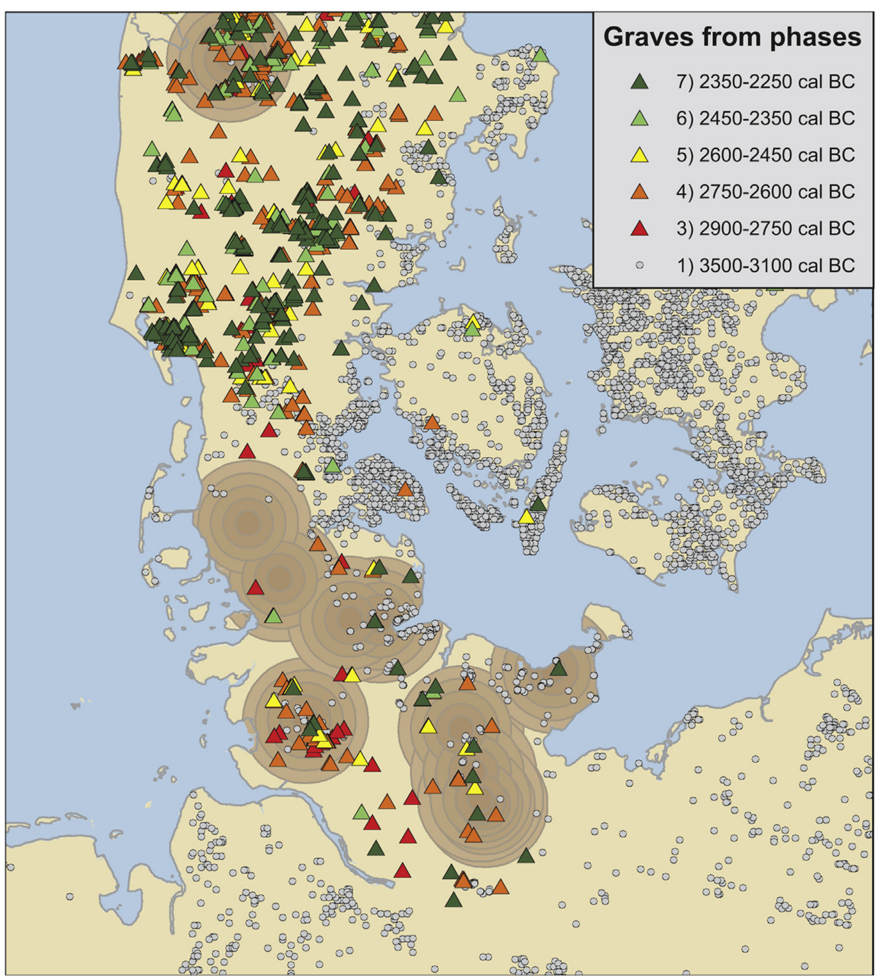

Fig. 2. Map showing distribution of grave types relating to different time periods on Jutland peninsula. Concentric rings indicate 25 km buffers around pollen sites.

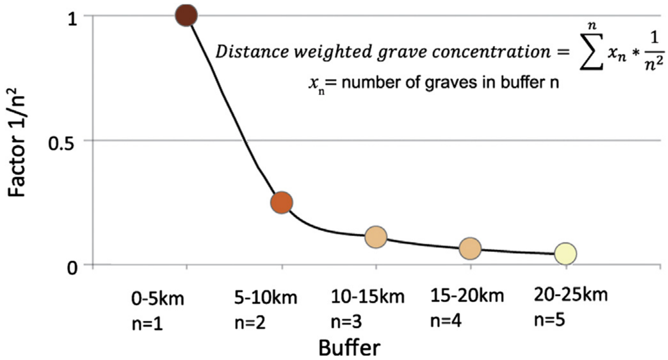

Fig. 3. Diagram explaining calculation of *distance weighted grave concentration*, i.e. the applied archaeological proxy for human activity, for pollen sites.

during phase 1 (3500–3100 cal BC) and relatively high during the Single Grave Period (phases 3–7).

The profiles of Lake Belau and Gr. Segeberger See lie geographically in between these two described areas and therefore allow the analyses of the development of human activity along a north–south transect. The data from Lake Belau closely resembles the pattern characteristic for the Baltic coast area, with the highest values for both proxies, recorded for the Megalithic construction phase (3500–3100 cal BC). For Gr. Segeberger See an intermediate pattern can be observed with comparatively high values for both proxies during the Megalith construction as well as during Single Grave phases.

Different and diverse patterns are observed for the sites from the old moraine area. The site of Horstenmoor is unique in that it comes from an area where values for the archaeological proxy are generally high, although fluctuating, whereas those of the palynological proxy remain comparatively low. Hörrmoss and Süderlügum (see Fig. 4), both sites from the northern part of old moraine area, are characterised by very low values for the distance weighted grave concentration throughout the investigated period. In Hörrmoss this is in agreement with low indication for human activity from the pollen data, i.e. *P. lanceolata* (Poaceae pollen, as for Süderlügum too, is regarded to derive mainly from grasses growing on the bog surface), whereas in Süderlügum human activity is indicated from phase 2 onwards.

Skånsø (Fig. 4), the site from Denmark, shows a pattern similar to the one typical for the central younger moraine area in

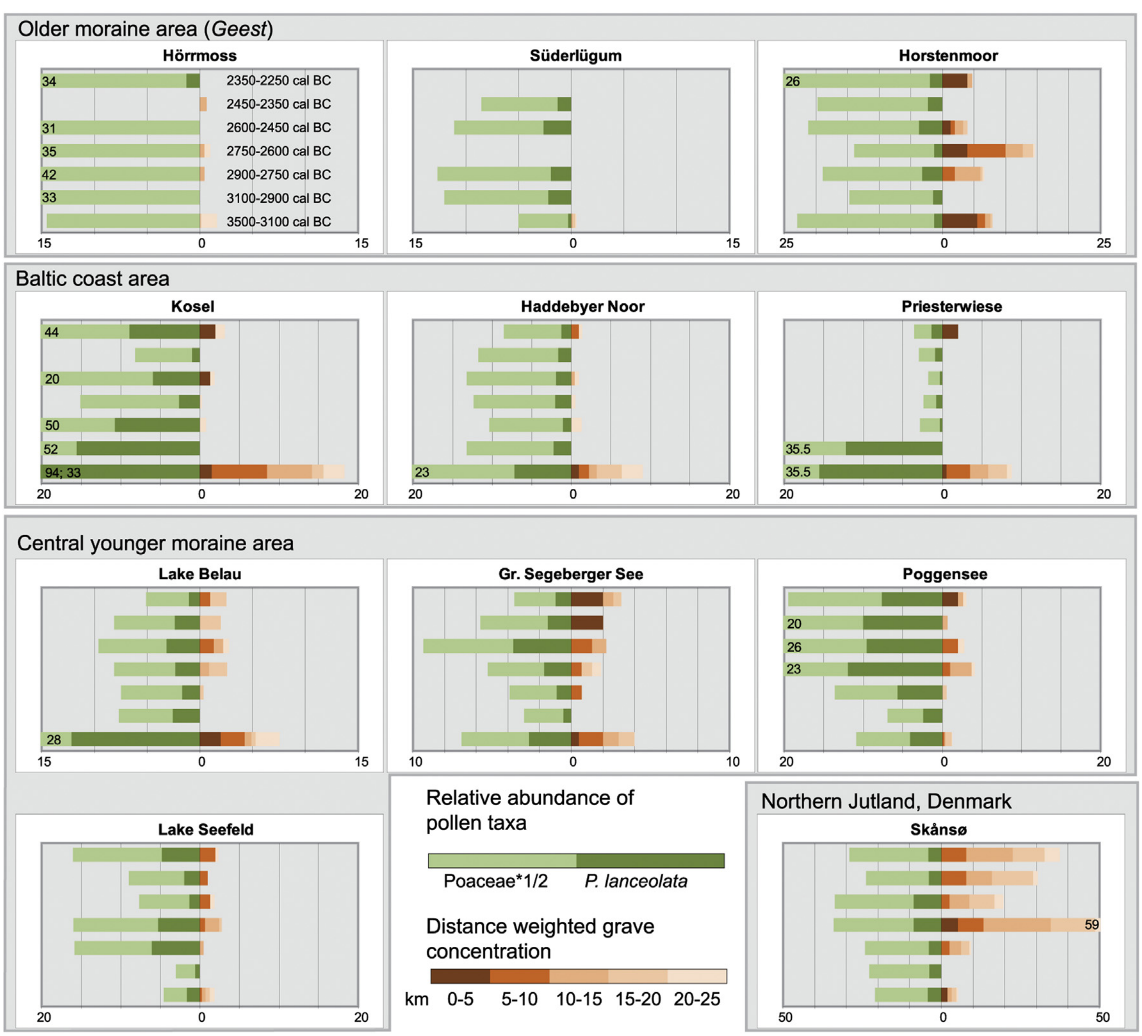

Fig. 4. Comparison of environmental (relative representation of Poaceae and *Plantago lanceolata* based on pollen sum of arboreal mixed oak forest species) and archaeological (*distance weighted grave concentration*, cf. Fig. 3) proxies for selected sites and time slices. Time slices are indicated in upper left diagram for site of Hörrmoos only, but apply correspondingly for the other sites. Note: proxies for various sites are not all plotted to the same scale.

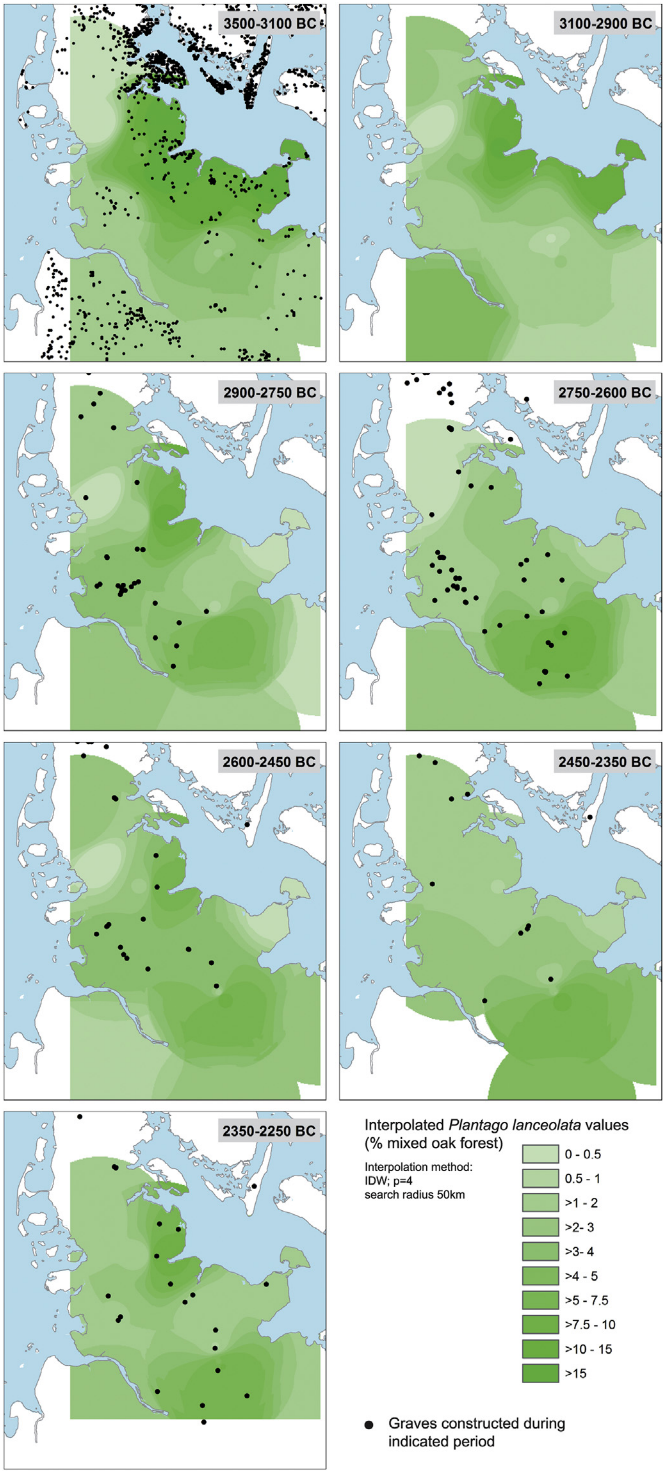

Fig. 5. Pollen isomaps of relative representation of *Plantago lanceolata* (based on pollen sum of arboreal mixed oak forest species) and grave distribution for selected time slices, showing the spatial development of human activity during the 4th and 3rd millennium BC in Schleswig-Holstein.

Schleswig-Holstein with relatively low values during phase 1 and 2 (3500–2900 cal BC) and higher values during the Single Grave Period (phases 3–7). Although the pollen data has quantitatively comparable values (e.g. *P. lanceolata* and Poaceae values range achieve maximum values of around 10 and 30% respectively), it is characterised by much higher density of archaeological graves.

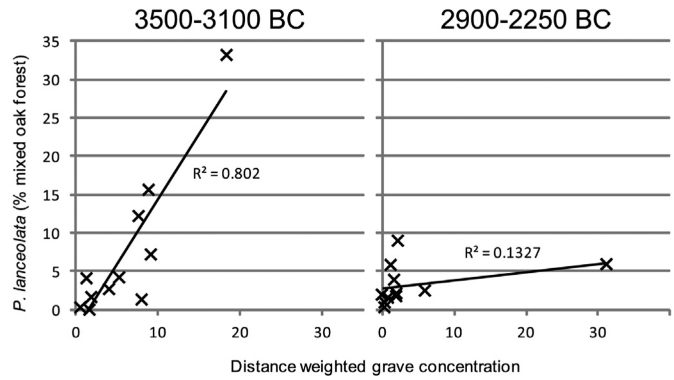

Fig. 6. Diagram showing results of linear regressions between environmental (relative representation of *Plantago lanceolata*) and archaeological (*distance weighted grave concentration*) proxies within the time slices 3500–3100 cal BC (Megalithic construction phase) and 2900–2250 cal BC (average data for Single Grave periods) for sites from Schleswig-Holstein and Denmark.

4. Interpretation and discussion

4.1. General considerations

When interpreting the presented data, proxy related uncertainties have to be considered. In case of the environmental data this includes archive related characteristics (e.g. archive type and size), sampling resolution and quality of time control (see also Table 2). Generally, archive size is determining the pollen source area for a site (Jacobson and Bradshaw, 1981; Prentice, 1985). Hereby, large archives are regarded to reflect more regional developments, whereas local developments often dominate at smaller sites. In our case, this has to be considered especially for small archives, such as Horstenmoor and Kosel (cf. Table 2), as the applied search radius for grave around a pollen site is rather large in comparison to the assumable main pollen source area. In case of bogs, the natural occurrence of grasses on bog surfaces complicates the usage of Poaceae as indicator of landscape openness. Therefore, high Poaceae values without corresponding *P. lanceolata* values (e.g. site of Hörrmoss) are not regarded to reflect human economic activity. Low sampling resolution (e.g. in case of Süderlügum and Hörrmoss) results in greater uncertainties of the environmental proxy, as average values only rely on few pollen spectra. The quality of the chronological data, e.g. number and sampling material of ^{14}C dates, has also to be considered. Age-depth models of exceptional high qualitative standards are available when AMS dates from terrestrial macrofossil dates and varve chronologies are combined (e.g. Lake Belau and Poggensee). Generally, chronological uncertainties have greater impact on short time slices, i.e. time slices relating to the Single Grave Period, in that the probability that both proxies relate to the same time span is lower. Therefore the authors refrain from assuming absolute synchroneity when interpreting these time slices, but rather focus on similar trends/developments during the Single Grave Period.

In case of the archaeological data, problems related with the representativeness of the data have to be considered as these are biased by several factors, inherent to all archaeological data. Besides the influence of preservation conditions as well as modern agricultural and industrial activities, a varying intensity of research is the most critical parameter affecting the archaeological record. In the case of the single grave barrows, these parameters are thoroughly discussed by Hübner (2005). She could demonstrate that on the Jutland peninsula the distribution of graves, at least on a supra-regional level, is not seriously biased by those factors.

Concerning megaliths, several investigations have confirmed, that medieval and modern stone architecture has not substantially blurred the present distribution pattern of megaliths (Lüth, 2009). The grave distribution recorded by Sprockhoff (1966) for Schleswig-Holstein fits well in the context of the overall distribution pattern of Funnel Beaker megaliths (Fritsch et al., 2010). However, irregularities on local and regional scales cannot be ruled out and have to be kept in mind.

The number of grave constructions recorded in the different phases vary substantially, especially between the megaliths (phase 1) and the Single Grave Barrows (phases 3–7). We assume, however, that this difference in building activity does reflect differences in cultural behaviour rather than a different likelihood for discovery of the different grave types.

4.2. Reconstruction of social and economic activity

Given the uncertainties of the used proxies – involving data of different types and quality, each associated with varying uncertainties (spatial and temporal) – the presented reconstruction should only be seen as a partially hypothetic scenario of economic–cultural interaction. However, due to the lack of substantial datasets from settlements related to our case study, the approach proposed here presents a model that has a stronger link to the archaeological and palynological data than any other so far.

In phase 1 (3500–3100 cal BC) the overall agreement between ritual activities and opened landscape is clearly visible (Fig. 5). This is also supported by good statistical correlation of both proxies for this phase (cf. Fig. 6). The area along the Baltic coast and the younger moraine area can be described as a core area of the Funnel Beaker groups in Schleswig-Holstein with a strong interlinkage between activity in the ritual and in the economic sphere (cf. Fig. 5). It is probably no coincidence that the core area of the first agricultural societies in Schleswig-Holstein matches the distribution of the most fertile soils in the study area. But the younger moraine area is likely to have had the highest concentration of erratic boulders, i.e. building material for megalithic, which also might explain the concentration of megaliths. The palynological evidence, however, supports that there has been only limited economic activity outside this Funnel Beaker core area, even if ritual activities are abundant. This is the case for at least two clusters of megaliths outside this core area. One is located in the central old moraine area, in the region of Albersdorf, the other on the Northern Friesian Isles, where there are some minor old moraine islands within the coastal marsh area (cf. Fig. 5). In case of the Albersdorf region the high concentration of megalithic graves cluster does not coincide with similar evidence of the environmental proxy (cf. pollen site Horstenmoor). On one hand it could be argued that economic activity in the Horstenmoor profile is strongly underrepresented due to the small archive size and hence small main pollen source area. But the presence of six megalithic graves within a distance of only 600 m to the sampling site (the nearest grave is c. 250 m away) might also point to different economic behaviour in the old moraine and younger moraine areas, despite similarity in ritual behaviour. This might have to be seen in an even more long-term tradition, as the earliest evidence for the cultural uniqueness of the Albersdorf region already dates to late Mesolithic times. Here, geoarchaeological investigations (Reiß et al., 2006) and the pollen diagram from Horstenmoor (continuous records for *P. lanceolata*, cf. profile Horstenmoor B, zone c in Dörfler (2005)) provide the earliest evidence for anthropogenic woodland clearance around the middle of the 5th millennium BC. We therefore suggest the existence of different socio-economic systems within the same archaeological culture. In case of the Albersdorf group a less marked interlinkage of ritual and economic activities, as compared to the younger moraine area, is suggested. A possible explanation is different ideologies that in the one case were centred around and based on subsistence and its possibility to create surplus, whereas this would not be the case in the other.

In phase 2 (3100–2900 cal BC), the archaeological proxy reflects a drastic decline in grave building activities throughout the whole region (Fig. 6), which coincides with a marked decrease in the pollen proxy. From this period, the re-use of already existing grave monuments is well documented, but new constructions of megaliths are so seldom (Hage, 2012; Furholt, 2012b) that they cannot be quantified in the context of our proxy. The pollen analytical proxy indicates continuing economic activity, although on somewhat lower levels, along the Baltic coast. For the central younger moraine area, i.e. the area around Poggensee, a decline in economic activity is obvious (cf. Fig. 5), corresponding to a supra-regional phase of reduced human activity and associated woodland regeneration in the south-western Funnel Beaker North Group (Feeser et al., 2012; Hinz et al., 2012).

During the Single Grave Period (2900–2250 cal BC) the spatial patterns of the proxy for economic and ritual activities become more diverse and changing.

The first Single Grave barrows are erected outside the younger moraine areas of the Baltic coast and are associated with evidence for elevated economic activity. One distinct cluster is located in the Albersdorf region, near the already existing megalithic graves. A second concentration of graves, although of a more scattered distribution, lies in the southern old moraine region, where they represent the first known burial monument type. Without assuming a strict synchroneity of the two proxies for the Single Grave phases, the spatial comparison (Fig. 5) suggests that this generally coincided with an increase of economic activity in the corresponding area.

In the southern central younger moraine area the increase of economic activity as seen in the pollen analytical data between 2900 and 2750 cal BC predates the construction of the graves (cf. Fig. 5), which are first recorded for the subsequent phase 4 (2750–2600 cal BC). This, however, on one hand might be due to chronological uncertainties. On the other hand, if we accept the chronological estimates – at least regarding the palynological data we deal with an area for which we have the best temporal resolution and time control (cf. Feeser et al., 2012) – it could point towards stepwise cultural shift, including social and economic aspects, from Funnel Beaker traditions to the adoption of new Single Grave ideologies in this region.

Along the Baltic coast, however, evidence for the adoption of the Single Grave tradition is rare and dates to the end of the Single Grave Period. Economic activity continues to decline or remains at relatively low levels. It seems that the inhabitants of this region, i.e. the old core area of the megalithic groups, had a closer cultural connection to the Danish Isles – another area were Single Grave tradition never really were adopted (Ebbesen, 2011) – than to the areas further west.

The lack of a significant correlation between the two proxies in the study area for the Single Grave Period might be explained by different reasons. On one hand it has to be kept in mind, that if we consider all sites from the study area we probably compare different groups/areas with inverse cultural or social developments. Whereas we deal with the emerging Single Grave phenomenon in the old moraine area, we have evidence for a cultural stagnation in the eastern Funnel Beaker core area during most time of the Single Grave Period. In the case of the latter area, a ritual conservatism in combination with reduced economic activity might have favoured the re-use of the graves, especially as they were designed as collective burials, rather than to result in the adoption of the new Single Grave burial tradition. The exclusion of sites from the Funnel

Beaker core area (i.e. Kosel, Haddebyer Noor, Priesterwiese) from the dataset, however, does not improve the statistical correlation for the Single Grave Period.

Another possible explanation for the lack of statistical correlation could be that the pollen signal for economic activity is differently reflected in the pollen sites. For example, the pollen sites from the Funnel Beaker core area are mainly lake sites (except Kosel), whereas sites from the main Single grave area, i.e. the old moraine area, are bogs. But even the comparison of two sites with similar archive characteristics (i.e. type and size) and similar pollen proxy values for the Single Grave Period, i.e. Poggensee and Skånsø, reveals strong differences in the degree of ritual activity. This supports the idea of greater variability in the relationship, i.e. a weaker interlinkage, of ritual activities and economic activities in the Single Grave periods.

Thus, we propose a social explanation for the differences in the interlinkage of economic and ritual activities, with strong relationship of both aspects in the eastern part of the study area (i.e. the core Funnel Beaker area) and a weaker one in the western part of the study area. This interpretation fits well with the model proposed by Kristiansen's (1984). He argues that Funnel Beaker burial rituals strongly highlight items connected to food production: megaliths are piles of stones to be cleared from potential fields, pottery vessels mainly symbolise their contents, and axes are necessary tools for forest clearance. Therefore, ideology and connected rituals are linked to subsistence production. Single Grave burials, on the other hand, highlight weapons and ornaments, which reflects an ideology with weaker or no links to subsistence production. Our results, furthermore, suggest that already within Funnel Beaker societies different ideologies existed during the megalithic phase, with a strong interlinkage of the ritual and economic sphere in the eastern Funnel Beaker core area. In western Schleswig-Holstein, e.g. in Albersdorf a weaker link between ideology and subsistence existed already during the Funnel Beaker Period, which might have favoured for the adoption of innovations connected to the Single Grave ideology.

5. Conclusion

The definition and comparison of a palynological proxy for economic activity and an archaeological proxy for ritual activity allows us to discuss the interlinkage of these two spheres of human activity in a diachronic and regional scope. In situations where settlement data is scarce and despite all uncertainties involved, this approach allows the proposition of a model of sociocultural change that is better founded on empirical data than all models proposed earlier. We found a significant correlation between the two proxies during the Funnel Beaker Period, and a general, yet not statistically significant, overall agreement of trends in the Single Grave Period.

We suggest that both during the Funnel Beaker Period, and Single Grave Period, different socioeconomic systems existed in different regions.

Along the Baltic coast and on the eastern younger moraine areas a strong interdependent relationship between economic and ritual activity is observed. To the west, evidence for such a strong interdependence is missing. We consider the eastern areas of Schleswig-Holstein to have been the southern part of a much larger Funnel Beaker core area centring around the Danish Isles (Fritsch et al., 2010; Furholt, 2012a). In the western area, i.e. the old moraine area, the first Single Grave burials were constructed after 2900 BC. This new tradition – being part the much wider evolving Corded Ware ideology – was only adopted in this part of our study area, which already during the Funnel Beaker Period had been separated from the Funnel Beaker core area by a weaker interlinkage of ritual and economic activity. In the Funnel Beaker core area, strong and interdependent economic and ideological structures seem to have led to a stable cultural system. This included the resilience to the adoption of innovations and ideologies, connected to the Corded Ware Complex in Europe after 2900 cal BC. In respect to ritual and economic productivity the cultural conservatism in this former innovative core area of the Funnel Beaker societies lead to a decline towards a region of peripheral importance during the later Neolithic in Northwest Europe.

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